

# Cold Climate Region: Case Study #2 City of Boulder, SmartRegs Ordinance Single Family Detached, 1960's Vintage

## Boulder, CO

Program	SmartRegs Ordinance
Location:	Boulder, Colorado
Building Type:	Single Family Detached
Building Size:	1,512 ft <sup>2</sup>
Foundation:	Unconditioned Crawlspace
Configuration:	3 bedrooms, 2 baths
SWA Contact:	Lois Arena

This single family detached home is located in Boulder, CO, in an area well known for its small, ranch style homes very often used as rental property. Typical of homes built in the 1950's and 1960's in Boulder, it is a 3 bedroom, 2 bathroom single-story house just over 1,500 ft<sup>2</sup> built over a crawlspace foundation.

The property manager for this rental became involved in the SmartRegs process early on because the owner of the property is on the board of a rental housing association in Boulder. The owner was interested in stepping through the process so that he could share the experience and lessons learned with members of the association. This home was actually used as a training site for several property owners.

After experiencing the process and understanding the requirements first hand, the property manager for this rental convinced several of her other property owners to sign up early for the SmartRegs audit. Basically, she wanted to determine if their rental properties complied with the City of Boulder's new requirements, and if they didn't, she wanted to ensure they had enough time to plan for needed upgrades.

Efficiency levels in this property were consistent with its year of construction (see table at right). Other than a couple of window replacements, no energy improvements appear to have been made to date. All ductwork and the heating system are located in the vented, unconditioned crawlspace. The addition at the back of the home has slightly higher wall and ceiling R-values than the original structure, but are not to the levels required by current codes.

Based on the blower door result of 2711 cfm@50 pascals, the estimated infiltration rate of this home is approximately 0.59 air changes per hour under natural conditions (ACHn) or 10.5 ACH@50 pascals.



**With an initial score of only 89 points on the SmartRegs checklist, this property owner must make some energy efficiency improvements to comply with Boulder's new ordinance.**

### Energy Efficient Features

Attic:	75% R10 rigid polyisocyanurate 25% R-19 batts
Walls:	Combination of R-11 & R-13 fiberglass batts
Windows:	Combination of double metal, low-e double vinyl, single wood w/ storms
Foundation:	Crawlspace 75 %, Uninsulated, R-0 Slab 25%, Uninsulated, R-0
Heating:	Forced air, natural gas, atmospheric, standing pilot in unconditioned space—68 AFUE
Cooling:	None
Ductwork:	Uninsulated in unconditioned crawl, extremely leaky
Hot Water:	Atmospheric, natural gas, conditioned space—0.56 EF
Air Leakage:	10.5 ACH@50 pascals, 0.59 ACHn

### Additional SmartRegs Features

None

**SmartRegs Checklist Score\*: 89 points\*\***

(The final score must be ≥ 100)

**HERS Index: 192**

\*100 points on the SmartRegs checklist should approximately equate to a HERS index of 120.

\*\*Auditor assumed a furnace AFUE of 80, should have been 68 according to RESNET standards. This would result in a SmartRegs score of 76.

## Boulder, CO

The owner of this property opted to use the prescriptive method of compliance and have the auditor fill out a checklist rather than perform energy modeling to determine if the property was in compliance. Based on the auditors assessment, this home scored 89 points on the SmartRegs checklist and is, therefore, not in compliance with the program. Because the minimum allowable score is 100 points, the owner will have to improve the property by 2019 in order to maintain the rental permit required by the City of Boulder.

When creating the prescriptive checklist, the authors set out to create a threshold that would apply to all homes. After extensive analysis, it was determined that 100 points on the checklist should correspond to a HERS index of 120 points, more or less. With a SmartRegs score of 89, the HERS index for this home should be considerably higher than 120.

SWA checked this assumption by modeling the home using REM/Rate, a simulation program used to analyze the energy use of residential buildings. As anticipated, the HERS index for this property was determined to be 192, significantly higher than 120.

Another goal in creating the SmartRegs checklist was to design a tool that would naturally lead property owners to the most cost-effective and highest impact improvements. For example, many more points are awarded for insulating an uninsulated attic than are given for insulating a slab foundation. Assuming both assemblies are poorly insulated, attic insulation will save much more money, be more cost-effective and is generally easier to accomplish than slab insulation.

Various improvement options for this property owner include:

- Crawlspace: insulating, air sealing and installing a vapor barrier; (14 points—includes points for putting ductwork in conditioned space)
- Reducing duct leakage to 20cfm/100 ft<sup>2</sup>; (5 points)

## Facts about SmartRegs

2 Compliance Paths: Prescriptive or Performance

- Prescriptive: 100 points on Checklist
- Performance: HERS Index <= 120



**All ductwork and the heating system were located in the vented, uninsulated crawlspace.**

- Installing compact fluorescent lighting (CFL's) throughout the home; (7 points)
- Installing a programmable thermostat; (1 point)
- Replacing the furnace with a high efficiency, 90+ AFUE model. (17 points)

The property owner is free to implement any combination of energy improvements as long as the final checklist score is at least 100. There are several combinations that would bring this home into compliance. For example, encapsulating and conditioning the crawlspace, reducing the duct leakage and installing a setback thermostat and CFL's would bring this home's true score (see footnote on previous page) to 103. The corresponding HERS index for the home would be 142. Although still higher than the intended HERS index of 120 points, this is a huge improvement. Replacing the furnace, sealing the ductwork and installing CFL's also brings the home into compliance with a SmartRegs score of 105, but again the HERS index is only reduced to 134, not 120.

There could be several reasons why the improved cases do not achieve a HERS Index of 120, but score 100 or more points on the SmartRegs checklist. For instance, the affects of window to wall ratios, solar exposure and roof color are not evaluated on the checklist but can drastically affect a HERS Index, especially in a climate like Colorado's. A score of 100 was meant to approximately equate to a HERS Index of 120. It is anticipated that some homes will exceed and some will be under this threshold.

## Boulder, CO

SmartRegs requirements were adopted to meet the city's sustainability objectives including environmental health, economic vitality and social equity. According to current statistics, rental properties comprise approximately 50 percent of Boulder's housing stock<sup>1</sup>. Therefore, by requiring property owners to upgrade rental properties, the SmartRegs program aids in advancing Boulder's community sustainability objectives, and will hopefully result in lower energy bills for tenants.

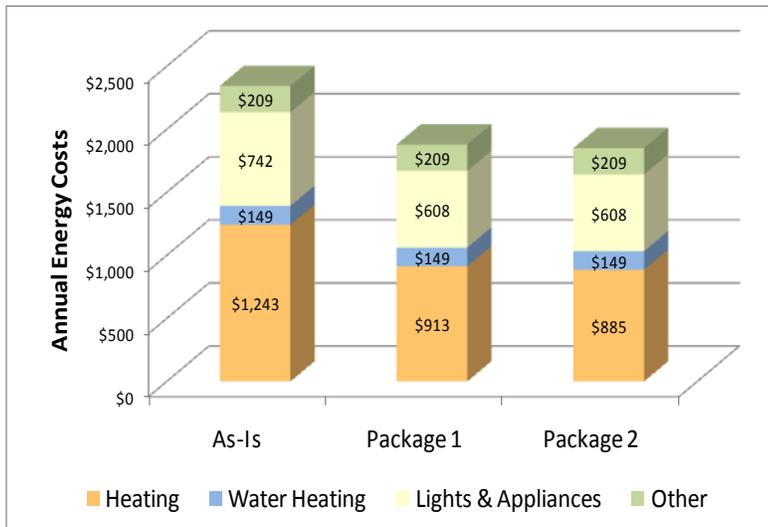
Predicted monthly utility bills for this property as it existed at the time of the initial inspection are displayed in the graph to the right. REM/Rate predicts an annual utility bill of \$2,343: about 53%, \$1,243, is attributed to heating.

Utility bill savings for the first option package discussed on the previous page—encapsulating and conditioning the crawlspace and installing a setback thermostat and CFL's (HERS index of 142) - results in predicted utility bill savings for the occupants of over \$464 per year.

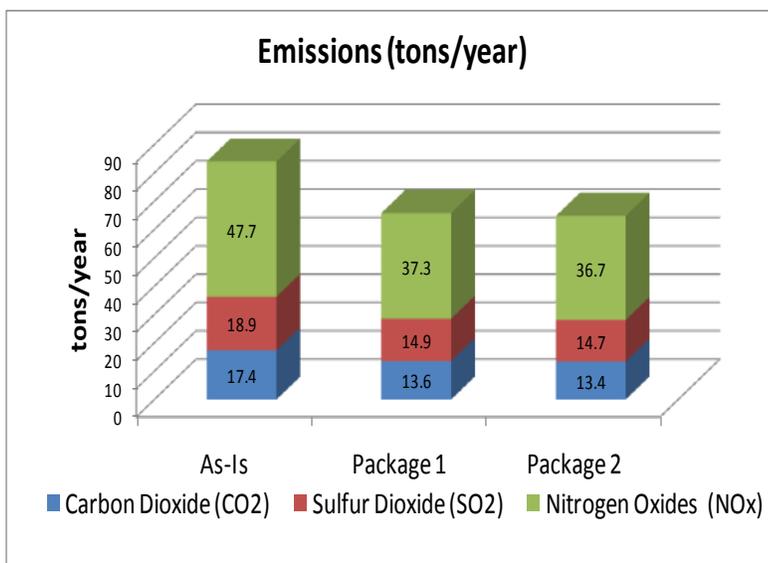
The second option—replacing the furnace, sealing the ductwork and installing CFL's (HERS index of 134) - results in predicted energy savings of \$492 per year.

Predicted emissions reductions are significant as well. Both upgrade packages are predicted to reduce NO<sub>x</sub>, SO<sub>2</sub> and CO<sub>2</sub> by more than 20%.

To better analyze programs like SmartRegs, comparisons to actual utility bills are critical. Unfortunately, obtaining utility bills from major providers has been and remains incredibly difficult, even with signed consent forms from homeowners or renters. While this is not necessarily a barrier to program implementation, it is a huge barrier to improving these programs and ensuring that the upgrades being recommended are effective from an energy reduction and a cost-effectiveness standpoint. Removing this barrier is essential in meeting long term program goals.



**Predicted utility bills from REM/Rate.**



**Predicted NO<sub>x</sub>, SO<sub>2</sub>, and CO<sub>2</sub> emissions from REM/Rate.**

<sup>1</sup>2011 SmartRegs Handbook, City of Boulder

### Boulder, CO

The property manager was interviewed to determine her feelings and concerns about Boulder's new SmartRegs ordinance. A summary of her opinions and suggestions for improvements are below.

**Q: Why did you decide to participate now and not wait till later in the process?**

A: The owner of this property is on the Boulder Rental Association Board and went through the process for educational purposes for the members of the Association.

This property manager was involved in an outreach/education effort to help inform other property managers and property owners about the SmartRegs program. The owner is on board with the requirements. Both owner and manager express that the program is not as difficult to comply with as anticipated.

**Q: How long has the owner owned this property?**

A: The owner has owned the property more than 30 years.

**Q: Are you educating the occupants about what and why renovations are taking place and how it will benefit them?**

A: The manager tries to inform the tenants about what is happening and how it will benefit them. She is not actively marketing the features yet.

**Q: What's the vacancy rate for your property?**

A: Basically zero. There are no problems with vacancy in Boulder.

**Q: What is your normal maintenance routine – i.e., every few months, once a year, on occupant turn over?**

A: Maintenance is performed at occupant turnover usually. Occupants typically turn over every year. Upgrades are performed as needed – i.e., a window doesn't work. Then just that window is replaced.

**Q: What has been the biggest challenge for you throughout this process?**

A: The biggest challenge has been distilling all the information down so that it is easy for the owners to understand. The manager would like educational tools to make this task easier.

**Q: What would you like other property owners to know?**

A: The process wasn't as difficult as she and the property owners originally anticipated. The information which was circulating about how much money the property owners would have to spend was not accurate.

**Q: Do you have any additional concerns about the program?**

A: The major concern is that the Boulder city council will keep increasing the requirements of the program.

*Steven Winter Associates, Inc. is the lead for the Department of Energy's Building America team called the Consortium for Advanced Residential Buildings (CARB).*

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